U.S. DEPARTMENT OF COMMERCE
National Technical Information Service
PB-277 845

A National Environmental/Energy Workforce Assessment. Hawaii

National Field Research Center, Inc, Iowa City, Iowa

Prepared for

Environmental Protection Agency, Washington, D C

Dec 77

PB 277 845

A National Environmental/Energy Workforce Assessment

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

Conducted by:

National Field Research Center, Inc.

P.O. Box 287

Iowa City, Iowa 52240

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO.	2.	3. RECIPIENT'S ACCESSION NO. PB277845
4. TITLE AND SUBTITLE A NATIONAL ENVIRONMENTAL/ENERGY WORKFORCE ASSESSMENT, Hawaii		5. REPORT DATE December 1977 - Date of Completion 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) National Field Research Center, Inc.		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS National Field Research Center, Inc. P.O. Box 287 Iowa City, Iowa 52240		10. PROGRAM ELEMENT NO. 2BC651 (36) 11. CONTRACT/GRANT NO. Grant #T900591010
12. SPONSORING AGENCY NAME AND ADDRESS U.S. Environmental Protection Agency Office of Federal Activities (A-104) 401 M Street, S.W. Washington, D.C. 20460		13. TYPE OF REPORT AND PERIOD COVERED Phase I Final Report 14. SPONSORINC AGENCY CODE

15. SUPPLEMENTARY NOTES Phase II will comprise approximately five volumes and will be available in September 1978. Phase III will be available in September 1979.

16. ABSTRACT

This study is one of 70 volumes assessing the workforce needs (manpower needs) for pollution control and abatement in the United States for the five-year period of 1976 through 1981. Seven fields for pollution control — air, noise, pesticides, potable water, radiation, solid waste, and wastewater — are analyzed, together with energy-related programs currently accentuated by tne national effort to solve energy supply problems.

Designed as Phase I of a three-phase program, the complete assessment includes the following volumes: one each for the 50 states, the District of Columbia, Puerto Rico, and the Virgin Islands; one for each of the ten EPA regions; a one-volume National Abstract; a volume on National Legislation; a volume on Business and Industry; and a four-volume National Summary. The information was gathered through extensive personal interviews with responsible federal, state, and local officials in every state; with officials of representative private industrial and commercial firms; and with representatives of national industrial and trade organizations.

Phase II will develop a broad national inventory of the entire range of post-secondary and higher education training offered in the pollution control and energy areas cited above, and Phase III will offer demonstrations for curriculum changes or modifications which appear necessary to assure an adequate and properly trained national environmental/energy workforce.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS		b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Planning	Employment	National Environmental/Energy Workforce Assessment	
Regional Planning	Economic Surveys		
State Planning	Energy Management		
State Agencies	Pollution Control		
Federal Government Planning	Environmental Management		
	Environmental Education		
Labor Force	Environmental Sciences		
Manpower	Conservation		
Forecasting	Environment		

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS (This Report)	21. NO. OF PAGES
Release Unlimited	20. SECURITY CLASS (This page)	22. PRICE PCA05 MFA01

EPA Form 2220-1 (9-73)

NATIONAL ENVIRONMENTAL/ENERGY

WORKFORCE ASSESSMENT

for

HAWAII

Conducted by:

NATIONAL FIELD RESEARCH CENTER, INC

Under Grant from:

UNITED STATES

ENVIRONMENTAL PROTECTION AGENCY

Grant #T900591010

1977

This document has been reviewed by the Environmental Protection Agency and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

National
Field
Research
Center, Inc.

Box 287

Iowa City, Iowa 52240

(319) 351-8789

INTRODUCTORY NOTE

The National Environmental/Energy Workforce Assessment was conducted by National Field Research Center, Inc. with main offices in Iowa City, Iowa. The following personnel have had primary responsibility for the Assessment and project report.

IOWA CITY, IOWA
- Dr. Darold E. Albright, President
- Paul E. Bridges, Executive Director
- Dr. Richard L. Benesh, Project Director
- Judith J. Gordon
- Alan M. Stowell
- Anita M. Stowell
- Mary Kay (Edge) Wade

ATLANTA, GEORGIA
- Elizabeth G. Nielsen, Regional Director
- Robert Oxberger

DENVER, COLORADO
- Nancy C. Dillenberg, Regional Director

SEATTLE, WASHINGTON
- Steven Silva, Regional Director

WASHINGTON, D.C.
- Frank E. Smith, Project Coordinator
- Lloyd B. Chaisson, Assistant Project Coordinator
- Jack F. Seum

Additional research and clerical assistance was provided by Frederick M. Wall, Maxine Wolfe, Margaret Fehn, Sandra Hogsed, Karen Kirchoff, Sharon Leiker, Marilyn Low, Mary McCormac, and Joan Urquhart.

FIELD OFFICES

ATLANTA
2700 Cumberland Pkwy
Suite 150
Atlanta, GA 30339
(404) 433-2644

DENVER
2600 S. Parker Rd.
Suite 160, No. 6
Denver, CO 80232
(303) 751-4962

SEATTLE
927 United Pacific Bldg.
1000 2nd Ave
Seattle, WA 98101
(206) 623-9170

WASHINGTON, D.C.
1522 K Street, N.W.
Suite 600
Washington, D.C. 20005
(202) 223-9138

TABLE OF CONTENTS

	Page
ILLUSTRATIONS	iii
ACKNOWLEDGEMENT	iv
PREFACE	vi
FOREWORD	vii
STATE SUMMARY	1
STATE PROFILE	14
POLLUTION CONTROL AND ABATEMENT AGENCIES	17
POLLUTION CONTROL AND ABATEMENT PROGRAMS	20
I. Air	21
II. Noise	28
III. Pesticides	33
IV. Potable Water	41
V. Radiation	46
VI. Solid Waste	49
VII. Wastewater	56
VIII. Energy	66
SELECTED POST SECONDARY INSTITUTIONS WITH FORMAL ENVIRONMENTAL/ENERGY PROGRAMS	72
STATE LEGISLATION	76

NOTE: The Selected Bibliography is appended to each Regional Report.

ILLUSTRATIONS

Table		Page
I	State of Hawaii, Department of Agriculture, Current (1976) Certified Commercial Applicators	37
II	State of Hawaii, Pesticide Workforce in Public and Private Sectors, Current (1976) Staffing Level	37
III	State of Hawaii, Solid Waste Division, Current (1976) Staffing Level (est.), (Three Counties)	51
IV	Hawaii Municipal Solid Waste, Workforce Projections to 1982 (est.), Counties of Hawaii, Honolulu and Maui	52
V	Hawaii Department of Health, Wastewater Program, Current (1976) Staffing Level	60
VI	Hawaii Department of Health, Certified Wastewater Treatment Plant Operators, Voluntary Certification Program, Current (1976) Staffing Level	61
VII	Hawaii Department of Health, Wastewater Operations, Projected Staff Growth rates to 1982 (est.)	62

ACKNOWLEDGEMENT

Information for this report was compiled primarily as a result of interviews with professionals in the State Department of Health, Department of Agriculture, and Department of Planning and Economic Development. Appreciation is expressed to the following persons who provided their time and assistance to this project:

Mr. Thomas Anamizu, Chief
Noise and Radiation Branch
Hawaii Department of Health

Ms. Kathleen E. Armstrong
Environmental Protection and Health
Service Division
Hawaii Department of Health

Mr. Brian Choy
Environmental Protection and Health
Services Division
Hawaii Department of Health

Mr. James Y. Kim, Chief
Pesticide-Weed Control Branch
Division of Plant Industry
Hawaii Department of Agriculture

Dr. James Kumagai, Deputy Director
for Environmental Health
Hawaii Department of Health

Dr. Richard E. Marland, Director
Office of Environmental Quality Control
Office of the Governor

Mr. Shinji Soneda, Chief
Environmental Protection and Health
Services Division
Hawaii Department of Health

Ms. Norrie Thompson, Research Associate
State Center for Science Policy and Technology
Assessment
Hawaii Department of Planning and Economic
Development

Mr. Dennis Tulang, Environmental Engineering
Pollution Technical Review Branch
Hawaii Department of Health

Mr. Howard Wiig
State Energy Office
Department of Planning and Economic
Development

Mr. Charles K. Yasuda, Head
Division of Plant Industry
Hawaii Department of Agriculture

Mr. Harold J. Youngquist, Supervising
Project Engineer
Pollution Technical Review Branch
Hawaii Department of Health

Mr. Ralph K. Yukumoto, Chief
Pollution Technical Review Branch
Hawaii Department of Health

PREFACE

This study presents an analysis of existing workforce levels, training programs, and career potentials and develops five-year staffing level projections (1976 to 1982) based on available information for the State of Hawaii in the environmental pollution control areas of air, noise, pesticides, potable water, radiation, solid waste, wastewater, and energy. This report is one portion of a study of the fifty states, Puerto Rico, and the Virgin Islands that was conducted by National Field Research Center, Inc., of Iowa City, Iowa.

The data presented in this report was compiled through comprehensive on-site interviews with professionals working in the public and private sectors. Supplementing this method were telephone surveys, mail contact, program plans, and research of relevant literature. It should be pointed out that the data, where not documented by records, represent the best professional judgment of these experts.

FOREWORD

Information for this report was largely compiled from on-site interviews with professionals within Hawaii's state agencies with environmental protection functions and with professionals engaged in pollution control activities in the private sector. To strive for a higher degree of reliability, interviews were supplemented with telephone research. It should be noted that a large portion of the information contained herein represents the best professional judgments of those persons surveyed. The term "sources in the field" is used in this report to denote the pollution control professionals who provided information for the project. In cases in which more than one person provided input into a single program area, compilation of figures and recommendations was provided by the author. Much of the background material on agency programs, functions, and activities was obtained from program plans of the appropriate agencies.

This report provides information on the following eight pollution control fields: air, noise, pesticides, potable water, radiation, solid waste, and wastewater. In Section C of each chapter entitled, Workforce Projections, average per annum growth/decline rates are derived by first calculating each year's growth rate for each category. The sum of these figures under each category is then found and is divided by the total number of years, i.e., by five.

Within the agencies and industries that were researched, compartmentalization of employees into the eight pollution control areas is not

necessarily a clear-cut situation. Functions occasionally overlap, inter-divisional cooperation occurs, and certain components serve a supporting role to an entire agency. Efforts were made in the preparation of this report to provide sufficient information for the reader to have an understanding of those segments of the work-force that play a major role in environmental protection activities and to provide divisions in a logical, realistic, and understandable manner.

National Environmental Energy Workforce Assessment

Phase I

HAWAII

State Summary

I. AIR

Hawaii air pollution control programs are administered by the Department of Health, Environmental Protection and Health Services Division. The major activities of the air pollution control program include long-range planning, developing rules and regulations, monitoring the air environment, investigating and answering complaints, and enforcing regulations. Eight professional staff members work in the air pollution control program. Four are degreed engineers, and four staff members hold the position of Environmental Health Specialist. The Division indicated that due to fiscal constraints it would not experience any growth in program staff over the next five years.

The Department of Health, Medical Health Services Division, Laboratories Branch, provides three chemists and one federally assigned instrumentation technician to the air pollution control program. Since neither the staffing nor the functions of the Division is expected to increase, it is unlikely that laboratory staffing will increase either.

Sources indicate that there are an estimated 60 persons working in air pollution control in the private sector, approximately 20 of which are consulting engineers and scientists. The majority of the non-consulting workforce is employed by the sugar, cement, oil refining, and electric power industries. As with the public sector, no growth is expected in the private sector workforce over the next five years.

II. NOISE

Regulatory authority for the control of noise pollution is vested in the Department of Health, Division of Environmental Protection and Health Services, Noise and Radiation Branch, Noise Control Section. The professional staff of the Noise Control Section consists of nine Environmental Health Specialists and the Chief of the Noise and Radiation Control Branch. The section may experience a staffing increase of from five to nine more persons in the next five years. Additional positions will be filled by degreed scientists and by persons with background in law enforcement.

Estimates for workforce composition of the private sector include four acoustical engineers and up to 50 professional engineers, architects, and draftpersons who are involved in control of noise through equipment design. Little growth is expected in the private sector during the next five years. However, if stringent federal legislation is promulgated, workforce growth in noise control is likely to increase.

Training needs which have been identified for the State of Hawaii include acoustical theory, new equipment development, enforcement problems and solutions, planning, and developing effective regulations.

III. PESTICIDES

The Department of Agriculture, Plant Industry Division, Pesticide-Weed Control Branch is responsible for the administration, regulation, and enforcement of the pesticide program. The branch has a professional staff of eleven. Seven members of the staff are engaged in pesticide activities.

The University of Hawaii Cooperative Extension Service is responsible for the development of training programs for commercial and private applicators. The program is operated through the efforts of one pesticide coordinator and four supportive staff members. In addition, the 22 extension agents located on all the islands are responsible for providing the actual training and education support to private and commercial applicators who attend the CES tranining programs.

In addition to these two programs, the Department of Health, Sector Control Branch has been delegated the authority for the statewide training program for public health pesticide applicators. This program is staffed with one administrator and six entomologists.

Estimates for the private sector pesticide-related workforce include 1,294 commercial applicators and 6,000 farmers. Sources expect little workforce growth in either the public or private sector. The only state agency predicting growth is the Pesticide-Weed Control Branch of the Department of Agriculture which may require two more inspectors. The private sector workforce is sufficient to serve present needs.

IV. POTABLE WATER

The Hawaii Department of Health, Environmental Protection and Health Services Division has regulatory responsibility for the state drinking water program. As such, this Division carries out inspection of public water supply systems, review of construction plans, and investigation of complaints. One civil engineer, one planner, and one attorney devote part of their time to the drinking water program within the Division. In 1977, the Division may add one or two engineers to its water supply program staff to conduct activities for compliance with the Safe Drinking Water Act. In total, approximately 5 person-years will be devoted to water supply in 1977, and this figure is expected to remain the same or decrease slightly over the next five years.

The Honolulu headquarters and district health offices conduct inspections and collect water samples on a part-time basis. Approximately 20 sanitarians are active in this program. More responsibility for drinking water programs may be transfered to the districts during the coming five years, and as this occurs, staff time devoted to the water programs may increase somewhat.

Information on the private sector workforce is limited; however, the approximate nonclerical staffing level of the county water departments is 555 with an estimated 20% in administrative and engineering positions and 80% in laborer positions. Since water treatment is considered to be adequate, sources do not expect an increase in the demand for treatment plant operators over the next five years.

V. RADIATION

Principal responsibility for radiation protection is vested in the Hawaii Department of Health, Environmental Protection and Health Services Division, Noise and Radiation Branch. The radiation program is currently staffed with one environmental health specialist and a part-time administrator. An additional environmental health specialist position is authorized, but vacant. The radiation program expects to fill this vacancy in the coming year and add one more environmental health specialist by 1981 to assist in the licensing of radiological technicians.

Private sector data regarding the number of people employed in radiation control are limited. There are 22 facilities using industrial X-ray devices, and it is projected that each of these facilities probably has a safety officer responsible for the proper use of the equipment. It is further estimated that the 179 hospitals and 28 clinics using medical diagnostic equipment may also have one person in each facility responsible for the equipment. No growth is expected in the private sector for personnel engaged in the control of environmental radiation.

In summary, it is clear that the workforce in radiation protection is very small in Hawaii. Since there is little need for radiation protection in the state, workforce growth over the next five years is expected to be minimal.

VI. SOLID WASTE

Regulatory responsibility for solid waste is vested in the Hawaii Department of Health, Environmental Protection and Health Services Division. Within the Environmental Protection and Health Services Division, the Pollution Technical Review Branch and the Pollution Investigation and Enforcement Branch provide personnel for the solid waste management program. In 1976, approximately two person-years were devoted to the solid waste management section, with each of the branches contributing one person-year. The division expects little, if any, workforce growth over the next five years; however, if the resource recovery effort is expanded, one engineer may be added to the staff in 1979 or 1980.

Partial information is available on the private sector workforce. Data were collected on the disposal programs in Hawaii, Honolulu, and Maui counties. The data reflected a total of 157 persons employed in landfill operations within these counties. Collection system data were collected only in the Counties of Honolulu and Maui. Currently, a total of 462 persons staff collection programs within these counties. The disposal programs will experience a decrease in personnel as the municipal incinerators are closed in Honolulu. However, the average per annum growth for heavy equipment operators is 16%, reflecting primarily an increase in landfills and transfer stations in Honolulu. Minimal growth is expected in the number of persons working in collection systems. A resource recovery system and shredder are planned for the County of Hawaii by 1980 and will employ an added 15 persons.

VII. WASTEWATER

Within the Division of Environmental Protection and Health Service, the two branches primarily concerned with water quality control are the Pollution Technical Review Branch (PTR) and the Pollution Investigation and Enforcement Branch (PIE). Twenty-four professional staff members from the PTR and PIE Branches work in the water quality control program, and an additional five persons have been hired on a temporary basis for "208" planning. The Department of Health, Laboratories Branch, Medical Health Services Division devoted approximately 6 person years in 1976 to the water quality program. The water quality program will probably experience a decline in staffing over the next five years. No growth is expected in the laboratory staffing, and the "208" staffing positions are likely to be eliminated due to lack of sufficient funds.

The Division sources estimate that there are approximately 100 municipal treatment plant operators and 20 private treatment plant operators in Hawaii. Of the 120 estimated operators, 56 are currently certified under the voluntary program of the Hawaii Water Pollution Control Association. Due to planned construction and expansion, Division sources predict that the workforce requirements for the municipal treatment systems will more than double. It is projected that a total staff of 265 persons will be required by 1980, an increase of 135 positions.

VIII. ENERGY

The Hawaii Department of Planning and Economic Development (DPED) is responsible for energy management and development in the State. The Director of DPED acts as the Energy Resources Coordinator and is assisted by two staff officers within the Department, the State Energy Office and the Center for Science Policy and Technology Assessment. The State Energy Office has a professional staff of two, the director and a research analyst. Similarly, the Center for Science Policy and Technology Assessment has a professional staff of two, again, a director and a research analyst. The State Energy Office anticipates adding between eight and ten persons to its present staff in the next five years. This office will be seeking people with backgrounds in engineering, planning, economics, and environment. The Center for Science Policy and Technology Assessments expects no further growth beyond the current professional staff.

The size of the university and private industry workforce engaged in energy development is difficult to ascertain. Sources indicate that a total of 32,000 persons are involved in the science, engineering, and data processing workforce in Hawaii, and that this workforce is employed in over 375 companies or agencies. Research suggests that the workforce in the private sector engaged in energy research and development will grow as long as federal and state funding for this purpose continues to increase.

STATE OF HAWAII - SUMMARY

National Environmental/Energy Workforce Assessment
Pollution Control & Abatement Personnel
Projected Workforce Requirements (1976-1981)

Environmental Area	1976	1977	1978	1979	1980	1981	%/annum growth (average)
AIR[1]	72	72	72	72	72	72	0
NOISE[2]	64	64	64	64	64	64	0
PESTICIDES[3]	7,335	7,335	7,335	7,335	7,335	7,335	0
POTABLE WATER[4]	578	580	580	580	580	580	0
RADIATION[5]	2	2	3	3	4	4	n/a
SOLID WASTE[6]	621	621	600	604	627	630	0
WASTEWATER[7]	34	34	30	30	30	30	-2%
ENERGY[8]	4	4	4	4	4	12	40%
TOTALS	8,710	8,712	8,668	8,692	8,716	8,727	0

[1]The above includes estimates of total persons involved in both public and private sector air pollution control activities.

[2]The above includes estimates for both the private and public sectors.

[3]The above includes estimates for both the private and public sectors.

[4]This estimate includes data on the public sector, and limited statistics on the private sector

[5]The above is an estimate for the state agency only.

[6]This estimate includes public sector projections, and limited private sector estimates. The private sector figures include data from disposal systems in Hawaii, Honolulu, Maui Counties, collection systems in Honolulu and Maui Counties, and the proposed resource recovery system and the shredder in Hawaii.

[7]This estimate includes only state agency workforce projections, In addition to the state agency, there are approximately 120 operators and 30 supportive service personnel employed in municipal systems. The municipal workforce is expected to grow to 265 persons by 1981.

[8]This estimate includes only state agency personnel. The projected 32,000 persons employed in the science, engineering, and data processing fields were not included.

EDUCATION

The state higher education system in Hawaii is composed primarily of the University of Hawaii System. This is the state university and is constituted as a body corporate by the Constitution of the State of Hawaii. Its wide variety of activities include many which are comparable to those of other institutions of higher education throughout the country. Basically, the University is concerned with instruction, research, and service to its community. The University has instituted and developed programs which take advantage of Hawaii's subtropical, mid-Pacific location and its multi-racial composition. Such programs include those in tropical agriculture, marine biology, geophysics, and Pacific and Asian studies.

The University of Hawaii includes both four-year, graduate, and community college level institutions. Two of the environmental programs offered at the Manoa campus are examined in greater detail in the State Report.

Presently, there are no specific environmental programs on the community college level although courses which deal with the environment are available within various departments. Plans are in the developmental stage for a sewage treatment plant operator program, with two specific courses currently available in chemistry and microbiology.

LEGISLATION

The environmental/energy legislation for Hawaii was obtained by request from various agency personnel and through various library references. Summaries of the legislation deemed most relevant to the eight subject areas of the workforce assessment were prepared, and are included in the respective state reports. The following list of laws represents virtually all environmental legislation for the state. Only certain of the following laws were summarized; the list is presented to show, by title, the kinds of laws which have been enacted.

Environmental Quality Commission Law

Environmental Quality Control Law

State Environmental Policy Act

Hawaii Statute on Environmental Quality

Hawaii Pesticides Law

Pest Control Operators Law

National Environmental Energy Workforce Assessment

Phase I

HAWAII

State Report

STATE PROFILE

The 50th state in the Union, Hawaii occupies a unique and interesting chapter in the economic, political, and environmental history of the United States. The islands, wholly shaped by volcanic eruptions and the action of wind, sea, and rain upon the resulting lava formations, are located 2,397 miles west of San Francisco. Characterized by Mark Twain as "the loveliest fleet of islands that lies anchored in any ocean," the Hawaiian islands perform important military, transportation, and recreation functions for the entire Pacific Basin area.

The terrain is generally sloping, and rainfall runoff collects underground in the porous rock formations. The islands have a land area of only 6,425 square miles, making them 47th in size among the states. This area is divided into eight major islands and 124 small inlets stretching in a 1,500 mile crescent across the eastern Pacific. The volcanic activity which formed the island chain has largely subsided. Only two volcanoes on the island of Hawaii are still sporadically active.

The climate is generally warm and placid with great variations in local rainfall. From an average of 486 inches per year on Mt. Waialeale to only 9.5 inches in Puako on Hawaii, the islands' rainfall indicates that wide range of ecological conditions which attract the state's diversified population and industrial concerns.

Ethnically the state's population is as widely varied as its climate. Chinese, Japanese, Korean, and Filipino immigrants came in

large numbers to work on Hawaiian fruit plantations during the early 20th century. These racially varied peoples now far outnumber the original Hawaiian population. Combined with immigrants from Europe and the mainland United States, the islands' population is a heterogeneous mixture of races, cultures, and languages. The population is now 841,000, ranking Hawaii 40th in the nation.

While the state's rank in terms of personal income, value of manufactured goods, and retail sales is among the lowest in the United States, its cost of living is almost the highest. The largest source of income to the state's opoulation comes from defense expenditures, tourism, and agriculture. Most raw materials for heavy manufacturing and almost all building lumber must be imported from the mainland. Hawaii produces approximately 40% of the world's canned pineapple. Foreign exports consist largely of pineapple, sugar, clothing, and canned fish. There are no municipal governments or incorporated villages, and all taxation is levied by a centralized tax system. The state is divided into four counties.

Hawaii's environmental picture is unique among the 50 states. Because of their porous lava foundations, relatively small land area, and the action of waves and tides, the islands are ecologically fragile and contain small reserves of fresh water and arable land. The beaches are formed by wave action on coral shelves ringing the islands. These shelves protect the land mass from erosion by wave action and provide shallow, warm, protected waters for many forms of sea life. They also help provide the tourist attractions for which the islands are famous.

There are few mineral reserves on the islands, and raw materials for most manufacturing and industrial operations must be imported by ship or cargo aircraft. There are no coal or oil deposits.

The relatively high concentration of Hawaii's urban population and its almost total reliance on artesian wells rather than rivers for fresh water and waste water treatment pose special problems for the environment. Pollution is a serious matter in an area where the fresh water is limited. Sea dumping of community refuse and wastewater has caused some damage to vital coral reef protection in certain areas. All electric power is provided by oil-powered steam and diesel generators. Automobile pollution is a problem in the urban areas, although the trade winds help keep pollutants dispersed.

POLLUTION CONTROL AND ABATEMENT AGENCIES

The principal environmental agency in Hawaii is the Department of Health which has major responsibility for the air, noise, potable water, radiation, solid waste, and wastewater programs. In addition, the Department of Agriculture is the designated state lead agency for the pesticide pollution control program. The Department of Planning and Economic Development administers the energy policy and program planning, and energy research and development programs.

Within the Department of Health, the Environmental Protection and Health Services Division administers the six environmental programs mentioned above. Activities are carried out through the main headquarters located in Honolulu and through three District Health Offices located on the islands of Kauai, Maui, and Hawaii, as well as through the Laboratory Branch of the Medical Health Services Division, Department of Health. The Deputy Director for Environmental Health has responsibility for the entire pollution control program. Within the Division, pollution control activities are carried out by the Environmental Planning, Coordination and Liaison Office of the Director, Staff Services Office, the Pollution and Technical Review Branch, and the Pollution Investigation and Enforcement Branch.

The function of the Environmental Planning, Coordination and Liaison Office of the Director is to coordinate the development of environmental program strategies and to ensure that they are compatible with federal goals and policies. This office also provides liaison with EPA and other federal, state, and local agencies. It is staffed by the deputy director and a planner.

The Staff Services Office provides administrative assistance to the chief of the Environmental Protection and Health Services Division in the areas of program planning and budgeting, plan preparation, coordination and review, development of standards, rules and regulations, and public information and education. This office has a professional staff of three persons.

The Pollution and Technical Review Branch administers and coordinates the statewide engineering and technical functions of all the department's environmental programs but noise. Activity areas include permit issuance, municipal facility construction and technical review. The Pollution and Technical Review Branch has a professional staff of 15 members.

With a professional staff of 17, the Pollution Investigation and Enforcement Branch monitors and surveys air, water quality, and pollution sources and administers and enforces statewide air, water, and solid waste pollution regulations. Investigation of complaints, enforcement of regulations, routine monitoring and inspections, intensive surveys, and compliance monitoring comprise this branch's major activities.

The Noise and Radiation Branch, composed of 13 professional staff members, administers the statewide community noise control and radiation control programs, as well as a program of ventilation control.

In the Laboratories Branch, Medical Services Division, 20 chemists, microbiologists and laboratory technicians are involved in the department's pollution control program on either a full- or part-time basis.

As the state lead agency for certification of pesticide applicators, the Department of Agriculture is responsible for developing the state

plan for establishing applicator categories and standards, establishing certification procedures, and enforcing certification provisions. Within the Department of Agriculture, the Plant Industry Division, Pesticide-Weed Control Branch is responsible for carrying out this program. Eleven professional staff members, most of them agricultural scientists, are engaged in the activities mentioned above. Also contributing to the certification effort is the University of Hawaii Cooperative Extension Service, the Department of Health, Vector Control Branch, and the Pest Control Board.

Energy policy planning, and development is the responsibility of the Department of Planning and Economic Development. Headed by the Energy Resources Coordinator, who is also the director of the department, energy activities are carried out by the State Energy Office and the Center for Science Policy and Technology Assessment. While the State Energy Office is responsible for energy management and conservation planning and programs, the Center is responsible for long-term planning concerning research and development of alternate sources of energy. Five professional persons are involved in these activities. The small size of the staff necessitates that research and development projects be contracted to appropriate public and private sector sources.

Pollution Control and Abatement Programs

I. AIR

A. Introduction

The two main air pollution problems in Hawaii are carbon monoxide and particulates. Carbon monoxide is a particular problem in Waikiki and on the highways in general. Particulate emissions result from bagasse (sugar cane waste) combustion boilers, construction activity and agricultural burning. Also, in rural areas, there is a problem of fugitive dust produced by planting and harvesting. Eighty-two percent of the state's population resides on Oahu, and this is where the majority of industry is located. Thus, over 50% of emissions of TSP, SO_2, and NO_x emanate from that island.

The air pollution control program is administered by the Department of Health, Environmental Protection and Health Services Division. The major activities of the air pollution control program include long-range planning, developing rules and regulations, monitoring the air environment, investigating and answering complaints, and enforcing regulations. The overall air pollution control strategy is to maintain control over stationary sources. Rules and regulations are being developed to control mobile source air pollution. The federal government now has exclusive jurisdiction over emissions from vehicles, but the state may become involved by limiting the size and location of facilities which will attract a large number of vehicles in areas where the air pollution standards are being threatened. The state is also becoming involved in eliminating conflicts between environmental programs; such as exists between air and solid waste. These are ultimately land use problems, the solution to which will require major policy decisions.

Within the Division of Environmental Protection and Health Services, the two branches primarily concerned with air pollution control are the Pollution Technical Review Branch (PTR) and the Pollution Investigation and Enforcement Branch (PIE). The former branch administers and coordinates the statewide engineering and technical functions relating to environmental protection, including air pollution control. Its major activity for air pollution control is issuing permits. The latter branch monitors and surveys pollution sources and administers and enforces statewide regulations. In terms of air, its major activities are responding to complaints, investigation and enforcement, routine monitoring and inspections, and compliance monitoring.

In the private sector, the air pollution control workforce is located mainly in the sugar, cement, oil refining, and electric power industries, as well as with consulting engineers and scientists.

B. Workforce Profile

Data for the workforce profile and workforce projections sections were obtained through on-site and telephone interviews with professionals working in the public and private sectors in air pollution control. Of particular assistance were the Chief and Supervising Project Engineer, Pollution Technical Review Branch, Department of Health.

In the Division of Environmental Protection and Health Services, PTR and PIE Branches, eight professional staff members work in the

air pollution control program. Four are degreed engineers, with two trained in electrical engineering, one trained in chemical engineering and one trained in mechnical engineering. They work as environmental engineers. The other four staff members hold the position of Environmental Health Specialist and are either degreed physical and biological scientists or have equivalent experience.

The Department of Health, Medical Health Services Division, Laboratories Branch, provides three chemists and one federally assigned instrumentation technician to the air pollution control program. The Attorney General's Office provides attorneys when enforcement actions are undertaken. Hawaii has no municipal air pollution control programs.

Public and private sector sources indicate that there are an estimated 60 persons working in air pollution control in the private sector, approximately 20 of which are consulting engineers and scientists. The majority of the non-consulting workforce is employed by the sugar, cement, oil refining, and electric power industries. Agricultural associations may also have a professional research staff, composed of engineers and scientists, which is involved part-time in pollution control research including air pollution control. There are estimated to be five consulting firms in the state which do environmental work. Some University of Hawaii staff members also work as air pollution control consultants on a part-time basis.

In general, in a company, air pollution control and monitoring tasks are assigned to a staff engineer or chemist who along with a technician devotes part-time to this area. Those companies with corporate headquarters located in Hawaii may have a corporate environmental

staff. Corporate environmental staffs are responsible for environmental policy planning, long-range planning of facilities and equipment, conducting environmental studies, preparing environmental reports for regulatory agencies, keeping top management informed of new rules and regulations, auditing plant performance as it relates to air and other types of pollution control, and providing technical assistance in solving air and other pollution problems.

Field research suggests that the private sector workforce involved in air pollution control works in this area on a part-time basis. If it is assumed that it devotes one quarter of its time to air pollution control activities, then approximately 15 person-years per year are spent on air pollution control in the private sector in Hawaii. Most of this workforce is professional and represents the following occupations: chemist, chemical engineer, mechanical engineer, industrial engineer, and attorney.

In sum, it appears that there are approximately 25 professional and technical person-years per year devoted to the field of air quality control in the public and private sectors. This estimate includes the full- or part-time workforce of approximately 60 persons. The amount of effort on a person-year basis toward air quality control is divided fairly evenly among the private and public sector, although the private sector employs a larger number of people who then work in this area as an adjunct to other job assignments.

C. Workforce Projections

Sources in the state air pollution control program expect no further employment growth in the program over the next five years. These sources indicate that they would like to add two more engineers to the staff so that work can be conducted in greater depth. However, it is unlikely that the state legislature will appropriate funds for this purpose. Therefore, the air pollution control program is expected to operate with four engineers and four scientists at least to 1982. Laboratory staffing growth for the air program is dependent on the expansion of the air pollution control program of the Division of Environmental Protection and Health Services. Since neither the staffing nor the functions of the division in air is expected to increase, it is unlikely that laboratory staffing will increase either.

There has been no turnover among the engineers and scientists in the state air pollution control program over the past several years. The attractiveness of living conditions in the state combined with a tight job market for engineers and scientists account for low turnover rates in the professional positions.

As with the public sector, no growth is expected in the private sector air pollution control workforce over the next five years. Ninety-five of the 96 major sources are in compliance with regulations or have agreed to compliance schedules and little economic growth is expected in the state over the next several years, thereby limiting the number of additional air pollution sources. Private sector sources indicate that when an air pollution problem does arise, consultants are often

hired to solve the problem, a cost-effective solution for most companies in the long-run. Moreover, these sources point out that the majority of consultants engaged for this purpose are headquartered on the mainland. Specific turnover rates for public sector professional and technical persons are not available. However, sources in the field indicate that turnover is extremely low. Contributing to the low turnover rate, again, is the desirability of Hawaii as a place to live and the tight job market.

It is clear, then, that public and private sector workforce growth in the air pollution control field in Hawaii is likely to be minimal or nil. Additional efforts necessitated by more stringent federal regulations would probably be carried out by the present workforce or by consultants, many of whom are not based in Hawaii.

D. Training and Certification

Training for state air pollution control personnel is provided through attendance at EPA sponsored training seminars as well as through informal and ongoing on-the-job training. In the private sector, staff members may already be skilled in air pollution control work and may augment their knowledge through informal on-the-job training.

The University of Hawaii, public health and engineering departments offer some training related to air pollution control. However, many professionals in the field obtain training at mainland educational institutions.

Public sector sources suggest that EPA-sponsored training courses would be more useful if the content were more technical.

E. Career Potential

The foregoing suggests that career potential in air pollution control in Hawaii is extremely limited. No growth is projected for this workforce over the next five years, and turnover rates are minimal.

F. Conclusion

The air pollution control field is staffed primarily by engineers, chemists, and attorneys. Growth in the field and career opportunities will be restricted. There will be few, if any, workforce opportunities in the public sector because of limited funding, and the rate of growth for public sector opportunities is limited because little economic growth is expected and because most companies have an adequately staffed environmental component. Ninety-five major installations are either in compliance with regulations or have agreed to an acceptable compliance schedule. The compliance status of one major installation is not known. Problems that do arise which current staff cannot handle are usually solved through the retainment of consultants, most of whom are from the mainland.

II. NOISE

A. Introduction

Because Hawaii has a dense population concentrated on a relatively small land area, noise pollution has become an increasing problem. The State has legislation to prevent, control, and abate excessive environmental noise. Regulatory authority for the control of noise pollution is vested in the Department of Health, Division of Environmental Protection and Health Services, Noise and Radiation Branch, Noise Control Section. The functions of this section include the following:

1) Establish rules and regulations to control vehicular noise;

2) Establish rules and regulations for control of excessive non-vehicular noise;

3) Investigate, survey, and make recommendations to decrease noise levels;

4) Issue permits for noise which does not meet regulations;

5) Monitor noise sources to determine compliance;

6) Conduct surveys of vehicular and non-vehicular noise.

In practice, the Noise Control Section concentrates enforcement of community, rather than vehicular noise, and preferring to leave enforcement of "unreasonable" or nuisance noise to local police. The staff of the Noise Control Section, accompanying local police, operates equipment to measure vehicular noise.

The City of Honolulu has a municipal noise ordinance which applies to nuisance and zoning. The latter is covered by acoustical criteria in the legislation while the former category does not. Thus, nuisance noise has no quantitative emissions limits and is therefore difficult to control. Other work being done in noise control includes that of the Department of Labor and Industrial Relations, Occupational Health Branch which administers, develops, and enforces the State's Occupational Safety and Health law and in-plant industrial hygienists who are also concerned with occupational noise control. Finally, several engineering firms are engaged in equipment design.

B. Workforce Profile

Data for the workforce profile and workforce projections sections were obtained through on-site interviews with professionals in the noise control field. The Chief of the Noise and Radiation Branch, Department of Health offered valuable assistance in data collection.

The professional staff of the Noise Control Section consists of nine Environmental Health Specialists (EHS) and the Chief of the Noise and Radiation Control Branch who also is an EHS and devotes half-time to the noise control program. The position of EHS requires a bachelor's degree in a physical or biological science.

Professionals in the field estimate that there are four acoustical engineers in the state who are engaged in acoustical consulting.

In addition, there may be up to 50 professional engineers, architects, and draftpersons who are involved in control of noise through equipment design, in particular, noise control in air conditioning equipment.

It appears, then, that there are approximately 60 persons involved in control of environmental noise pollution, with over 80 percent of the effort taking place in the private sector.

C. Workforce Projections

The Noise Control Section may experience a staffing increase of from five to nine more persons in the next five years. Staffing growth is dependent on the number of complaints received. If complaints increase significantly, this section may expand monitoring of vehicular noise activities to 24 hours daily. Additional positions will be filled partly by degreed scientists and partly by persons with backgrounds in law enforcement.

Because environmental noise pollution control has not developed as a distinct professional area and regulations regarding environmental noise are relatively loose, little growth in the private sector workforce is expected by sources in the field. If stringent federal legislation is promulgated, workforce growth in noise pollution control is likely to increase.

D. Training and Certification

The Noise and Radiation Branch provides informal and ongoing on-the-job training for the staff involved in the noise control program. In addition, this branch provides education, by request, to companies

interested in noise control. The University of Hawaii provides some training in noise control engineering. However, many professionals in the field attend mainland educational institutions for training.

E. Career Potential

Since workforce growth in the area of noise pollution control is extremely limited, there is little evidence that a significant number of career opportunities will develop over the next five years. In addition, experts in the field indicate that they are aware of no new or unique careers emerging in this area. Environmental engineers and technicians employed in industry may be assigned noise control duties as an adjunct to their other responsibilities. However, it is unlikely that distinct careers in noise control, other than equipment and building design, will be developing.

F. Conclusion

At the present time, the noise pollution control field is staffed primarily by engineers, scientists, architects, draftpersons and industrial hygienists. There appears to be little potential for distinct noise-related career opportunities to develop in the near future, particularly on the non-degreed technical level. If public awareness or national policy forces the development of environmental noise control regulations, there will be a need for trained scientists, engineers, planners, systems analysts, attorneys, and administrators, as well as for technicians. If development in this field should occur,

upgrade/enrichment programs will be necessary for involved personnel of all professions, and program development will be required, in particular, for training in less than degreed technical areas.

Public sector sources point out several areas of training needs for state noise control personnel. Specifically, a need for training exists in the following areas: acoustical theory, new equipment development, enforcement problems and solutions, planning, and developing effective regulations. Public sector sources suggest that the development of short courses which address these areas would be of concrete benefit to state noise program personnel.

III. PESTICIDES

A. Introduction

The State of Hawaii has been operating an interim certification program for private and commercial applicators since July 1, 1974. Temporary credentials are being issued to private and commercial applicators without qualification to purchase and use pesticides classified as restricted. The interim certification program is expected to be phased out early in 1977, and private and commercial applicators will then be certified in accordance with FIFRA and its amendments after demonstrating competency either by attending a training program and passing a written examination administered by the University of Hawaii Cooperative Extension or by taking and passing a written examination administered by the State Department of Agriculture. An estimated 1,294 commercial applicators and 6,000 private applicators are expected to be certified by October 1977.

The Hawaii Department of Agriculture is the designated lead agency for the certification of pesticide applicators. Through the Plant Industry Division, the department is responsible for the overall coordination and implementation of the certification program. Other regulatory activities of this department include registration of pesticide products, licensing of dealers, issuing special permits for aerial application of restricted use pesticides, and operating the interim certification program. The department maintains registration, inspection and sampling activities for approximately 2,300 EPA registered products and approximately 120 locally formulated

products which are distributed, sold, and used in the state. Approximately 120 dealers of restricted use pesticides are licensed annually. Dealers are required to have a person designated as a "qualified sales manager" to sell restricted-use pesticides. To act as a "qualified sales manager" it is necessary to pass a written examination administered by the department. The department also issues permits for aerial application of all restricted use pesticides and monitors such operations for compliance.

Other agencies which cooperate in the certification program for pesticide applicators are the University of Hawaii Cooperative Extension Service, the Vector Control Branch of the Department of Health, the Pest Control Board of the Department of Regulatory Agencies, and the Advisory Committee on Pesticides.

The University of Hawaii Cooperative Extension Service is responsible for training commercial and private pesticide applicators and for lending support to cooperating agencies in their development of training programs. The Vector Control Branch is responsible for administering the training program for public health pesticide applicators. The Pest Control Board licenses pest control operators, and the Advisory Committee on Pesticides advises and assists the Department of Agriculture in developing and revising the state's pesticide law and regulations and in providing expertise and recommendations on pesticide problems.

Sources in the field point out that perhaps the most serious pesticide problem for which a solution has not been found is that of

container disposal. Because of the limited land mass, the potential for water contamination, and the limited amount of money available to address the problem, adequate disposal methods have not been developed.

B. Workforce Profile

Data for the workforce profile and workforce projections sections have been obtained through on-site interviews with professionals in the field of pesticides. The Chief of the Division of Plant Industry and the Chief of the Pesticide-Weed Control Branch, Department of Agriculture, offered valuable assistance in the collection of these data.

The Department of Agriculture, Plant Industry Division, Pesticide-Weed Control Branch is responsible for the administration, regulation, and enforcement of the pesticide program. The Pesticide-Weed Control Branch has a professional staff of 11. Seven staff members are engaged in pesticide activities and include the branch chief, a pesticide supervisor, an entomologist, and four pesticide inspectors. The pesticide inspectors hold bachelor's degrees in entomology, horticulture, and agricultural agronomy. Pesticide activities include market surveillance and inspection of pesticide products, sampling pesticide products for analyses, administration of examinations to commercial and private applicators as applicable, certification and issuance of credentials to applicators, inspection of pesticide use by commercial and private applicators, and filing reports on suspected violations.

At the University of Hawaii Cooperative Extension Service, one pesticide coordinator and four additional staff personnel are responsible for the development of training programs for commercial and private applicators. This includes development of training materials and manuals, scheduling teaching programs with extension agents on neighboring islands, and preparing and administering written examinations. In addition, the 22 extension agents located on all the islands are responsible for providing the actual training and educational support to private and commercial applicators who attend the CES training programs. In total, 27 University of Hawaii Cooperative Extension Service staff members are involved in the pesticide program.

Six entomologists and the chief of the Vector Control Branch, Department of Health are responsible for the statewide training program for public health pesticide applicators. This staff develops and prepares training materials and the training manual, develops and administers the written examination, and trains all public health pesticide applicators.

The Executive Secretary of the Department of Regulatory Agencies is responsible for providing administrative support to the Pest Control Board. This includes administering and scheduling examinations for licensing of pest control operators.

The following table shows the estimated number of commercial applicators to be certified by category. These estimates were developed by Department of Agriculture officials.

TABLE I

STATE OF HAWAII

Department of Agriculture
Current (1976) Certified Commercial Applicators

Commercial Category	Estimated Number
1) Agricultural Pest Control	
a) Plant	100
b) Animal	2
2) Forest Pest Control	50
3) Ornamental and Turf Pest Control	300
4) Seed Treatment	0
5) Aquatic Pest Control	2
6) Right-of-Way Pest Control	100
7) Industrial, Institutional, Structural, and Health Related Pest Control	450
8) Public Health Pest Control	90
9) Regulatory Pest Control	75
10) Demonstration and Research Pest Control	125
TOTAL	1,294

In addition, approximately 6,000 private applicators are in need of certification.

The total estimated pest control picture is reflected by the following table in which figures are approximations of the workforce engaged in pesticides on either a full- or part-time basis.

TABLE II

STATE OF HAWAII

Pesticide Workforce in Public and Private Sectors
Current (1976) Staffing Level

Public Sector	1976
Department of Agriculture	7
Department of Health	7
State Extension	27
Pest Control Board	1
TOTAL	42
Private Sector	
Farmers	6,000
Owners/Operators/Applicators	1,294
TOTAL	7,294

C. Workforce Projections

Sources in the field expect little workforce growth in either the public or private sector. The public sector pesticide program is well staffed and the only agency that may experience any growth at all is the Pesticide-Weed Control Branch of the Department of Agriculture. This branch may acquire two more inspectors. However, this will not occur before 1980. Turnover rates in the public sector pesticide program are extremely low primarily because of the desirability of Hawaii as a place to live combined with a relatively tight job market. Similarly, no further growth is likely to occur in the private sector among commercial and private applicators. The number of applicators is sufficient to serve present needs, and Hawaii's finite land mass restricts further growth in activities which would lead to a need for the use of pesticides. Turnover among commercial applicators is also low since most are small, family owned and operated businesses.

D. Training and Certification

As pointed out above, the University of Hawaii Cooperative Extension Service is responsible for the training of most pesticide applicators and for lending support to cooperating agencies in the formulation of training programs. By November of 1976, Cooperative Extension Service extension agents had trained and certified 1,584 commercial and private applicators. The Vector Control Branch of the Department of Health is responsible for training the approximately 90 public health

pesticide applicators. Applicators must attend a six hour training course and pass a written examination. Private applicators with poor reading comprehension can arrange for an oral examination.

E. Career Potential

Because little growth is likely to occur in the public and private sector workforce over the next five years and because turnover rates are quite low, career opportunities in the field of pesticides will be limited. There is a need for research in pesticide container disposal. Also, Hawaii's location makes it an international center, and new pesticides are continually being introduced into the state. Consequently, research is needed to determine the effects of the new chemicals. However, funding for research is not currently available and may not be forthcoming in the next several years. The sugar and pineapple industries practice Integrated Pest Management (IPM). If utilization of IPM is adopted by other sectors of agriculture, there will be a need for trained professional and technical personnel.

F. Conclusion

Pesticide usage in Hawaii has probably reached its maximum. The finite land mass of the state serves to limit future growth. Accordingly, workforce growth in the area of pesticides is expected to be minimal over the next five years since both the public and private sectors are already well staffed. Pesticide container disposal and the effects of new chemicals require inquiry, but sufficient

funds are not available for this purpose. Sources in the field point out that state enforcement personnel need periodic upgrading in order to keep abreast of new technology in all areas of pesticides. These sources suggest that upgrade training could effectively be carried out by EPA. They emphasize that such training should address local needs. To ensure that commercial and private applicators are kept up-to-date with changing technology and maintain a continuing level of competence, the Department of Agriculture has provided for their re-certification every three years.

IV. POTABLE WATER

A. Introduction

There are approximately 70 municipal water supplies in Hawaii. Approximately 60 are equipped with chlorination units. In addition, the City and County of Honolulu Board of Water Supply operates one filtration plant and three aeration units, the County of Kauai Water Department operates a unit with filtration, flocculation, and chemical treatment capabilities, and the County of Hawaii operates a unit with filtration, flocculation, and sedimentation capabilities. There are an estimated 100 private water supply systems. Because of the small number of treatment plants in the state, no certification program for water treatment plant operators has been established or is being planned.

The Hawaii Department of Health, Environmental Protection and Health Services Division has regulatory responsibility for the state drinking water program. As such, this Division carries out inspection of public water supply systems, review of construction plans, and investigation of complaints. In 1976, a State Public Water System Supervision Program was initiated. Under this program, the Department of Health will qualify for primary enforcement responsibility for the Safe Drinking Water Act.

B. Workforce Profile

Data for the workforce profile and workforce projections were obtained through on-site and telephone interviews with sources at the Department of Health who are involved in the water supply program. Of

particular assistance was the staff of the Environmental Protection and Health Services Division, Department of Health.

Currently, in the Environmental Protection and Health Services Division one civil engineer, one planner and one attorney devote part of their time to the drinking water program. The attorney works as co-manager of the program and is provided by the EPA Region IX office. In addition, 20 sanitarians working in the Honolulu headquarters and district health offices (Kauai, Maui, and Hawaii) conduct inspections and collect water samples on a part-time basis. The Department of Health, Laboratories Branch, Medical Health Services Division devotes approximately 5 person-years per year to water supply. Contributing to this effort are chemists, microbiologists, and laboratory technicians.

No information is available on the number of operators assigned to the chlorination units. The other six units are run by four full-time operators. One of the plants assigns two persons as part-time operators to substitute when the regular operator is on vacation. The approximate non-clerical staffing level of the county water departments is 555 and is distributed as follows: City and County of Honolulu, 400; County of Kauai, 35; County of Hawaii, 50; County of Maui, 70. An estimated 20% or 111 of these positions are administrative and engineering and 80% or 444 are labor. The City and County of Honolulu Board of Water Supply operates its own laboratory. This lab includes three persons working in the chemistry section and seven in the microbiology section.

In total, then, approximately 600 professional, technical, and labor personnel are employed in the water supply program in the Department of Health and in county water departments in Hawaii.

C. Workforce Projections

In 1977, the Environmental Protection and Health Services Division may add one or two engineers to its water supply program staff to conduct activities for compliance with the Safe Drinking Water Act. In total, approximately 5 person-years will be devoted to water supply in 1977, and this figure is expected to remain the same or decrease slightly over the next five years. The Department of Health plans to transfer more responsibility for the drinking water program particularly in the area of water sampling to the county water departments. As this occurs, staff time devoted to the public water program at the Department of Health may decrease somewhat, and staffing in the county water departments may increase.

Since water treatment is considered to be adequate in Hawaii, few, if any, new full-scale chemical treatment plants will be built in the next five years. Consequently, sources in the field do not expect the demand for treatment plant operators to increase over the next five years. There will be, however, an increase in the use of filtration units since some water systems utilize surface water supplies with turbidity problems. Increased use of these particular units may generate some increase in potable water-related employment; however, it is likely that most of the personnel necessary to operate such units will be assigned by water suppliers from existing personnel.

Overall, little workforce growth is likely to occur in the drinking water program. County water departments may augment their staffs as their water sampling responsibilities increase, but staff increases are expected to remain fairly low. The Division of Environmental Protection and Health Services may acquire two additional engineers for the water supply program over the next five years. However, the amount of time devoted to this program by Department of Health sanitarians may decrease as some of their functions are transferred to the county water departments.

D. Training and Certification

At the present time, the Department of Health does not provide any training for water department personnel but does provide informal on-the-job training for departmental personnel engaged in the water supply program. The training of treatment plant operators occurs primarily on-the-job and is the responsibility of the county water departments. Beginning in the spring of 1977, the Department of Health will train county water department personnel and private suppliers in the collection of drinking water samples and in other facets of water supply operations in preparation for assuming primary enforcement responsibility for the Safe Drinking Water Act.

E. Career Potential

Since there will be little growth in employment in the water supply program in Hawaii, career potential is extremely limited.

F. Conclusion

The State of Hawaii is planning to assume primary enforcement responsibility for the Safe Drinking Water Act. When primacy is assumed, approximately 170 additional water supply systems will come under the new Federal definition of a public water supply. Despite this, little staffing growth is expected to occur in the Department of Health water supply program. Rather, county water departments will be encouraged to assume increased responsibility for regulation and water sampling. In sum, little workforce growth is likely to occur in the area of water supply over the next five years. Consequently, few career opportunities will develop.

V. RADIATION

A. Introduction

Principal responsibility for radiation protection is vested in the Hawaii Department of Health, Environmental Protection and Health Services Division, Noise and Radiation Branch. The activities of this program include:

1) Drafting rules and regulations to control radiation;

2) Reviewing plans for new and extended installations of x-ray units and radioisotopes to provide for the protection of workers, patients, and the public from hazardous radioactivity;

3) Conducting surveys of x-ray, electronic installations, and radioisotope laboratories to determine and minimize exposures to ionizing and non-ionizing radiation;

4) Controlling the use and storage of radioisotopes in laboratories;

5) Operating a radiological fallout surveillance station;

6) Investigating complaints concerning radiation and securing compliance.

Hawaii is not an NRC agreement state.

B. Workforce Profile

Data for the workforce profile and workforce projections was obtained through on-site visits with professionals in the field.

The Radiation Program currently has one environmental health specialist (EHS) to conduct the activities described above. In addition, the chief of the Noise and Radiation Branch, also an EHS, devotes half-time to the radiation program. A position for one more EHS is authorized but vacant. The position of EHS requires a bachelor's degree in the biological or physical sciences.

Private sector data regarding the numbers of people employed to protect the environment from radiation are tentative at this time. The number of facilities using industrial X-ray devices in Hawaii is 22. Each of these facilities is likely to have a safety officer responsible for the proper use of the equipment. In addition, the 179 hospitals and 28 clinics using medical diagnostic equipment may also have one person in each facility responsible for the equipment. These persons may be radiologists, physicians or chief radiologic technologists. Hawaii has no nuclear power plants in operation or planned for construction.

C. Workforce Projections

The Radiation Program expects to fill the vacancy for EHS in the coming year and to add one more EHS by 1981 to assist in the licensing of radiological technicians. No growth is expected in the private sector for personnel engaged in the control of environmental radiation.

D. Training and Certification

The Noise and Radiation Branch provides on-the-job training for staff members. The University of Hawaii also provides training in radiation. Sources in the Noise and Radiation Branch point out that there is a need for EPA-sponsored short courses in radiological health and laboratory methods and analysis for training of state staff.

E. Career Potential

Because of the minimal amount of workforce growth expected in Hawaii in radiation control, little career potential exists in this area.

F. Conclusion

Although specific estimates are not available, it is clear that the workforce in radiation protection is very small in Hawaii. Since there is little need for regulation in the state, workforce growth over the next five years is expected to be minimal.

VI. SOLID WASTE

A. Introduction

Regulatory responsibility for solid waste is vested in the Hawaii Department of Health, Environmental Protection and Health Services Division. The policy of the Department, as stated in the "Consolidated Environmental Program Plan - FY 1977", is to continually upgrade facilities through regulation and technical assistance to meet environmental standards and to encourage recycling and resource recovery. The department maintains a policy of requiring high environmental standards for land disposal functions to promote recycling. That is, by removing the option of open dumping and open burning, the true environmental costs of solid waste disposal become apparent, thereby making alternatives such as recycling more attractive.

Although the staff of the Environmental Protection and Health Services Division is gaining expertise in resource recovery technology, conflicts between solid waste and air quality objectives have caused unresolved policy problems which may limit the amount of resource recovery activity in the state. Specifically, the implementation of a resource recovery facility on Oahu would cause more air pollution. Reconciliation of this conflict is difficult because the air and solid waste programs operate independently of each other and under separate regulatory authority. The proposal put forth to reorganize the Department of Health is designed, in part, to eliminate program conflicts of this type through a greater integration of program goals and operations. However, Department of Health sources indicate that such a reorganization is not likely to occur.

There is disagreement in the state as to whether or not a hazardous waste problem exists. Hawaii has no major chemical producing industries and only two oil refineries, but there may be a pesticide disposal problem. EPA has granted $55,000 for a special study of hazardous wastes in Hawaii, Guam, and American Samoa. The results of this study will contribute to policy development concerning the management of hazardous wastes in Hawaii.

B. Workforce Profile

Data for the workforce profile and workforce projections were obtained through on-site and telephone interviews with professionals in the field. Supplementing this method was a solid waste workforce questionnaire mailed to each of the counties by Environmental Protection and Health Services Division.

Within the Environmental Protection and Health Services Division, the Pollution Technical Review Branch (PTR) and the Pollution Investigation and Enforcement Branch (PIE) provide personnel for the solid waste management program. The PTR Branch issues permits for solid waste disposal sites and provides technical assistance and the PIE Branch conducts semi-annual to annual field inspections to determine compliance with solid waste regulations. In 1976, approximately two person-years were devoted to the solid waste management section, with approximately one person-year contributed by PTR environmental engineers and one person-year contributed by PIE environmental health specialists (EHS). The position of EHS requires a bachelor's degree in a biological or physical science.

Of the questionnaires sent to the four county (Hawaii, Honolulu, Kauai, Maui) department of public works, three were completed and returned. The following workforce information is for the Counties of Hawaii, Honolulu and Maui.

TABLE III

STATE OF HAWAII

Solid Waste Division
Current (1976) Staffing Level (est.)
(Three Counties)

Position	1976
Engineer	7
Heavy Equipment Operator	27
Weighmaster	9
Other	114
TOTAL	157

The total of 157 includes personnel operating landfill sites, transfer stations, and municipal incinerators. The 'other' category includes 43 incinerator operators, 24 incinerator maintenance personnel, 14 incinerator supervisors, 9 ash truck drivers, 8 accounting personnel, 7 landfill caretakers, 6 laborers, 2 transfer station superintendents, and 1 engineering aide.

C. Workforce Projections

The Environmental Protection and Health Services Division expects little, if any, workforce growth over the next five years. One additional engineer may be added to the staff in 1979 or 1980 if resource recovery efforts increase.

Workforce projections for the Counties of Hawaii, Honolulu and Maui were obtained from the questionnaire and are shown in the following table. Note that the data for collection refers only to the Counties of Honolulu and Maui.

TABLE IV

HAWAII MUNICIPAL SOLID WASTE

Workforce Projections to 1982 (est.)
Counties of Hawaii, Honolulu and Maui

Collection	1976	1977	1978	1979	1980	1981	%/annum turnover (average)	%/annum growth (average)
Driver	133	133	133	134	135	136	n/a	.4%
Helper	304	304	304	307	307	309	n/a	.3%
Other	25	25	25	25	25	25	n/a	0
Disposal								
Weighmaster	9	9	9	9	9	9	n/a	0
Heavy Eq. Op.	27	27	48	48	50	50	n/a	16%
Other	121	121	79	79	84	84	n/a	- 6%
TOTAL	619	619	598	602	610	613		-.2%

*Collection statistics include only the counties of Honolulu and Maui.

In collection, the 'other' category includes two light truck drivers, 15 supervisors, 5 superintendents, two swampers, and 1 foreman. Growth in all collection positions will be minimal over the next five years in Honolulu and Maui.

The disposal statistics include the workforce employed at the landfills, transfers stations, and municipal incinerators. Overall employment in disposal is projected to decline because of the closing of municipal incinerators in Honolulu. However, the average per annum growth for heavy equipment operators is 16 percent, reflecting primarily an increase in landfills and transfer stations in Honolulu. The County of Maui expects no growth in its solid waste workforce, while the County of Hawaii projects an increase of four landfill caretakers and two equipment operators in 1980.

The County of Hawaii expects to have a resource recovery site operational by 1980 to be staffed as follows:

Foreman	1
Line Operator	1
Loader Operator	1
Laborer (Mechanic Helper)	2
Laborer (Spotter)	2
Laborer (General)	3
Mechanic	1
TOTAL	11

The County of Hawaii also will install a shredder at one of its landfills by 1980. Staffing is projected as follows:

Shredder Operator/Mechanic	1
Line Operator	1
Driver/Compacter Operator	1
Laborer/Caretaker	1
TOTAL	4

It does not appear at this time that a resource recovery facility will be built in the County of Honolulu in the next five years. If policy changes are effected so that such a facility is built, the Department of Health estimates that it might employ between 50 and 60 people in supervisory, operating, and support positions.

In summary, workforce growth in solid waste is projected to be slight over the next five years. However, the types of activities being conducted will change. Specifically, many incinerator operations will be closed, while the number of landfills and employment at landfills will increase. On the Island of Hawaii, two resource recovery operations are expected to begin in 1980.

D. Training and Certification

The Division of Environmental Protection and Health Services does not engage in the training of county solid waste personnel, and any training that does occur is provided by the counties. The division offers informal on-the-job training for its employees, and division employees also attend EPA sponsored training sessions. The University of Hawaii Public Health and Engineering School offers some instruction in solid waste management. However, many people involved in solid waste management in a professional capacity obtain training at mainland educational institutions.

E. Career Potential

The only area of major career potential that might develop is in resource recovery. Because of conflicts between resource recovery and

air pollution goals, though, resource recovery activities may be restricted in the next five years. If this field should develop, career opportunities will be available for highly trained engineers, geologists, and hydrogeologists, as well as for skilled equipment operators, electricians, and mechanics.

F. Conclusion

Two major areas of policy are currently under consideration in the state, and the types of decisions made will have significant workforce and training implications. A reconciliation of the goal conflict between the solid waste and air management programs may be encouraged by the Resource Recovery and Conservation Act. Until decisions are made with regard to future resource recovery activities, workforce projections cannot be established and training needs cannot be determined. In addition, the hazardous waste study now being conducted will affect future activities in this area. If hazardous waste is found to indeed be a problem for Hawaii, new disposal sites or improved methods of handling hazardous wastes will be necessary. This suggests that a capable workforce may have to be developed, an effort which might require establishing training programs since such programs do not already exist in the state. Because the operation of resource recovery facilities requires a much larger ratio of skilled technicians and laborers than professional engineers and scientists, training programs would have to be geared toward providing appropriate skills to technical personnel.

VII. WASTEWATER

A. Introduction

There are 28 municipal and seven major private wastewater treatment plants in Hawaii. The plants have primary, advanced primary, or secondary treatment capability. Since the number of existing treatment plants in the state is relatively small, Hawaii does not have a mandatory certification program for wastewater treatment plant operators. Because of extensive ongoing construction of public facilities and more complex treatment technology, legislation has been drafted to institute mandatory operator certification, and state government sources indicate that legislative approval is likely to be forthcoming. The Hawaii Water Pollution Control Association does have a voluntary certification program through which approximately one-half of the treatment plant operators in the state have become certified. In total, the municipal and private wastewater treatment systems employ an estimated 150 persons in operational, administrative, laboratory, and clerical positions.

The Hawaii Department of Health, Environmental Protection and Health Services Division, has regulatory responsibility for the state's water pollution control program. The major activities of this program include long-range planning, setting standards, monitoring the coastal and freshwaters of the state, reviewing plans and specifications for new sewage systems, and enforcement of regulations.

The department's goal has been to control water pollution through the use of permits which require polluters to develop a schedule of

compliance to meet water quality standards. Water pollution has been attacked where it is most serious and where it results from the discharge of point sources and controllable non-point sources. So far, the private sector has borne significant impact and costs of water pollution control since state and federal aid through the construction grants program has been available for abatement of municipal wastewater discharges only.

The state does not have total delegation for the Construction Grants Program and is negotiating with EPA for delegation of those program areas that will speed up the construction grants process. New wastewater dischargers must meet all effluent limitations at the time the discharge first occurs.

During 1976, the Areawide Waste Treatment Management Program mandated by Section 208 of the Federal Water Pollution Control Act Amendments of 1972 was initiated and will have significant impact on the activities of the Environmental Protection and Health Services Division. This program is funded for the period of June 1, 1976-November 1, 1978. Under 208 planning, attention is being directed to the identification and control of non-point sources of pollution. The 208 planning is designed not only to address water quality but also to encompass the total environmental management process. In conjunction with this concept, the management of liquid, solid, and gaseous wastes has been combined into a single program in the division.

As set forth in the Department of Health "208 Areawide Waste Treatment Management Work Plan,"(revised draft,) September 1976, "208" planning money will be used for the following:

1) To conduct a detailed analysis of each water quality segment where standards are not now being met to determine the nature and extent of non-point source pollution, the cause and effect relationships specific to that area, and the necessary control measures needed. Water quality standards and classification of each water quality segment will be examined at the same time to determine whether revisions need to be made.

2) To secure the services of a financial consultant to determine the relative costs of control actions and their effectiveness and to recommend appropriate methods of financing both the non-point and other control actions needed on each island to achieve water quality standards.

3) To develop a site-specific, non-degradation policy and preventive control measures for segments where water quality standards are now being met or will be when effluent limitations are imposed.

4) To conduct the required social, economic, and environmental assessments of these actions.

The counties, which are equivalent to mainland "regions", will assume the major role in plan implementation and continued update of the adopted plan.

The state has also begun to develop an underground injection control (UIC) program. Surveys of fresh groundwater and underground wastewater injection are being conducted to be followed by the development of UIC criteria, policies, and state regulations.

B. Workforce Profile

Data for the workforce profile and workforce projections were obtained through on-site and telephone interviews with sources at the Department of Health who are involved in the water quality program.

Within the Division of Environmental Protection and Health Services, the two branches primarily concerned with water quality control are the Pollution Technical Review Branch (PTR) and the Pollution Investigation and Envforcement Branch (PIE). The PTR Branch administers and coordinates the statewide engineering and technical functions relating to the environmental programs of the department, including water quality. The major activities are permit issuance, administration of municipal facility construction, and technical review. The PIE Branch monitors and surveys pollution sources and administers and enforces statewide regulations. Its major activities in terms of water quality control are inspection of facilities, routine and compliance monitoring, investigation of complaints, enforcement of water quality regulations, and conducting water quality surveys.

Twenty-four professional staff members for the PTR and PIE Branches work in the water quality control program and an additional five persons have been hired on a temporary basis for "208" planning. The Department of Health, Laboratories Branch, Medical Health Services Division devoted approximately six person-years in 1976 to the water quality program. Contributing to this effort were chemists, microbiologists, and laboratory technicians. The current staffing level,

by position, of the Department of Health water quality control program, including laboratory personnel, is shown the the following table:

TABLE V

HAWAII DEPARTMENT OF HEALTH

Wastewater Program
Current (1976) Staffing Level

Position	1976
Engineer	11
Chemist	3
Biologist	2
Lab Technician	1
Other	17
TOTAL	34

The engineers are classified as environmental engineers and have civil and sanitary engineering backgrounds. The chemist, biologist, and lab technician staffing levels represent person-years of effort toward the water quality program contributed by the Laboratories Branch, rather than the total number of people involved in the program. This is because 15 laboratory personnel contribute various percentages of their time to water quality control activities. The "other" category includes two administrators who are environmental engineers, one geologist, and eleven persons classified as environmental health specialists (EHS). The position of EHS requires a bachelor's degree in the physical or biological sciences. The remaining four positions in the "other" category are temporary "208" positions and include a social economist, a public participation coordinator, a water quality liaison, and a "208" community liaison. One engineering position is also a "208" position. Funding for the "208" planning staff will continue until November 1, 1978.

Division sources estimate that there are approximately 100 municipal treatment plant operators and 20 private treatment plant operators in Hawaii. Since certification of operators is not mandatory, the State does not have a system for the classification of operators. Fifty-six operators have become certified under the voluntary program of the Hawaii Water Pollution Control Association. Grades of certification range from I to IV. Certification is by skill level, not by type of plant operated, with Grade I representing the lowest skill level and Grade IV the highest. Statistics on voluntary certification, by classification, are shown in the following table:

TABLE VI

HAWAII DEPARTMENT OF HEALTH

Certified Wastewater Treatment Plant Operators
Voluntary Certification Program
Current (1976) Certification Participants

Classification	1976
I	39
II	7
III	6
IV	4
TOTAL	56

Division sources estimate, further, that approximately 30 persons in the municipal systems are employed in administrative, laboratory, and clerical positions.

In total, a workforce of over 180 people is employed in water quality control in the State. Approximately 150 persons are employed at municipal and private wastewater treatment facilities and approximately 34 professional and technical personnel are employed in the Department of Health water quality program.

C. Workforce Projections

The Department of Health water quality program will probably experience a decline in staffing over the next five years. No growth is expected in laboratory staffing, and although the Department is requesting that the "208" positions become permanent, sources at the Department suggest that the State legislature is not likely to appropriate funds for this. The Department does expect to obtain one permanent engineering position in the next five years, thereby yielding a net decline of four positions. Workforce projections for the State water quality program are as follows:

TABLE VII

HAWAII DEPARTMENT OF HEALTH

Wastewater Operations
Projected Staff Growth Rates to 1982 (est.)

Position	1976	1977	1978	1979	1980	1981	%Turnover	Increase/ Decline
Engineer	11	11	11	11	11	11	9%	0
Chemist	3	3	3	3	3	3	n/a	0
Biologist	2	2	2	2	2	2	n/a	0
Lab Technician	1	1	1	1	1	1	n/a	0
Other	17	17	17	13	13	13	8%	-5%
TOTAL	34	34	34	30	30	30		-2%

Turnover rates are low because of the desirability of Hawaii as a place to live combined with a relatively tight market for both engineering and science-related jobs.

Twelve municipal wastewater treatment plants capable of advanced primary or secondary treatment are projected to be built by 1980, and 5 plant expansions are planned. Two plants will be going from primary to secondary treatment and 3 plants will simply expand their facilities. Department of Health sources predict that the workforce employed at municipal treatment systems will more than double. Specifically, it is projected that a total staff of 265 persons will be required by 1980, an increase of 135 positions. An estimated 110 of the new positions will be for treatment plant operators and 25 for administrative, laboratory, and clerical personnel.

D. Training and Certification

As pointed out above, there is no mandatory certification for treatment plant operators. However, a mandatory certification program may be instituted by the state in the next several years. The Environmental Protection and Health Services Division provides occasional week-long training seminars for treatment plant operators. These training sessions are usually conducted once each year on Oahu and are attended by 20 to 25 people. In 1976, four of these classes were conducted on the various islands, and a total of 80 operators attended. If operator certification becomes mandatory, the division's objective is to establish a more formal and comprehensive statewide training program for

operators and laboratory personnel. Because the demand for additional treatment plant operators promises to be high over the next five years, the division is exploring the possibility of establishing a training program through the Hawaii community college system.

The division provides informal on-the-job training for its staff, and staff members attend EPA-sponsored training courses. The University of Hawaii engineering department also provides instruction in wastewater treatment. Much professional education, however, is received primarily from mainland educational institutions.

E. Career Potential

The demand for personnel for all facets of municipal wastewater treatment operations will increase over the next five years because of the extensive construction program. Positions will develop mainly for treatment plant operators but will also be available for administrative, laboratory, and clerical personnel. According to Department of Health estimates, over 100 additional treatment plant operators will be needed by 1980. The water quality program of the Department of Health is likely to experience a decline in staffing over the next five years. Accordingly, career opportunities in water quality control in the state government will be severely limited.

F. Conclusion

The greatest amount of activity in Hawaii's water quality program is occuring in "208" planning and in the Construction Grants Program. While the long-range workforce implications of "208" planning are difficult to assess at the present time, the increase in the number of municipal wastewater treatment facilities effected by the Construction Grants Program will double the staffing level in this area in the next five years. Hawaii is also becoming active in UIC, but this effort is projected to have little effect on workforce needs.

As new municipal facilities are built and the technology of treatment increases in complexity, the need for additional training of plant operators and laboratory personnel will also increase. To meet this need the Department of Health is considering contracting with a sanitary engineering firm to evaluate alternative programs of statewide training. Also under consideration is the institution of an operator training program through the Hawaii community college system.

VIII. ENERGY

A. Introduction

Of all the states, Hawaii is the most dependent on imported petroleum to fulfill its energy needs. There are no known fossil fuel reserves in the state. A small amount of energy is provided by the burning of bagasse (sugar cane waste) and hydroelectric power but nearly all is provided by imported petroleum, 35 percent from the mainland and 65 percent from foreign sources. Hawaii, however, does have the potential for developing a variety of low- or non-polluting energy sources including geothermal, solar, ocean thermal, wind, waves, tides, and ocean currents. A study by the Governor's Committee on Alternate Energy Sources suggests that geothermal, wind, solar, ocean thermal, and solid waste/bioconversion have "highly significant" potential. That is, they have the potential for supplying 10 percent or more of Hawaii's future energy needs. The Committee also concludes that there are no short-term substitutes for oil that can be introduced in Hawaii that will significantly reduce the state's dependence on imported petroleum in the next ten years.

Hawaii may lead the nation in dollars spent per capita on alternative energy resource research. Funding for energy research and development in Hawaii between 1972 and 1976 totaled over $8 million and is around $6 million for fiscal year 1976. At least 60 energy-research projects and programs are completed, in progress, or scheduled to begin with fiscal year 1977 funds. These projects, by category, are as follows:

Category	Number
Ocean Thermal Energy Conversion	13
Wind	5
Bioconversion and Waste	10
Solar Heating	3
Systems Studies	6
Geothermal	12
Conservation and Demonstration	8
Support	3

The Hawaii Department of Planning and Economic Development (DPED) is responsible for energy management and development in the State. The Director of DPED acts as the Energy Resources Coordinator and is assisted by two staff offices within the Department, the State Energy Office and the Center for Science Policy and Technology Assessment. The State Energy Office is responsible for energy management and conservation planning and programs. Its activities include:

1) Coordinating the State's energy conservation and allocation programs;

2) Recommending and maintaining contingency plans for implementation in the event of fuel shortages;

3) Preparing forecast reports through the collection of supply and demand data and production and consumption trends;

4) Developing and implementing voluntary and/or conservation programs;

5) Conducting public education programs to promote more efficient use of energy resources;

6) Monitoring and recommending State positions on Federal energy legislation and policy.

The Center for Science Policy and Technology Assessment is responsible for long-term planning concerning research and development of alternate sources of energy. Its activities include:

1) Providing advice on state funding of alternate energy research and development proposals;

2) Preparing and promoting proposals to Federal agencies and private industry to support research and development activities in Hawaii;

3) Promoting conferences, symposia, seminars, and institutes in alternate energy research and development;

4) Publishing and disseminating alternate energy information and reports.

The center is currently providing funds for a variety of projects including the development of a master plan for aquaculture, alternative energy with emphasis on geothermal, and a plan to conduct a feasibility study on manganese nodules.

In addition, the Natural Energy Laboratory of Hawaii (NELH) and the Hawaii Natural Energy Institute (HNEI) were established in 1974 by state legislation to conduct energy research.

B. Workforce Profile

Data for the workforce profile and workforce projections were obtained through on-site interviews with professionals in the field.

The State Energy Office has a professional staff of two, the director and a research analyst. Similarly, the Center for Science Policy and Technology Assessment has a professional staff of two, again, a director and a research analyst. Because of its small staff, the Center contracts research projects to University of Hawaii personnel, consultants, and private industry.

Because of their dispersion throughout the state, the size of the university and private industry workforce engaged in energy development is difficult to ascertain. A report by DPED entitled, Hawaii's Natural Energy Resources--1976, indicates that the total number of people in the science, engineering, and data processing workforce in Hawaii is 32,000 and that this workforce is employed in over 375 companies or agencies. Persons in this workforce are involved or have the potential to become involved in various areas of energy research and development. The University itself has more than ten departments, centers, and laboratories which currently conduct such research. Agriculture, industry, other state agencies, and the county governments are all becoming active in energy research and development.

C. Workforce Projections

The State Energy Office anticipates adding between eight and ten persons to its present staff in the next five years. This office will be seeking people with backgrounds in engineering, planning,

economics, and environment. The Center for Science Policy and Technology Assessments expects no further growth beyond the present professional staff of two and will continue to conduct research through the funding of consultants. Field research suggests that the workforce in the private sector engaged in energy research and development will grow as long as federal and state funding for this purpose continues to increase.

D. Career Potential

Hawaii is ideally situated for the development of a wide variety of low-polluting energy systems. Furthermore, the federal and state governments regard energy research and development as vital to the continued prosperity of the United States. As a result, funding in Hawaii for this purpose is fairly generous and many career opportunities are developing for professional and highly trained scientists and engineers to conduct research into the various energy alternatives and to develop systems for their practical application.

E. Training and Certification

The University of Hawaii with its many energy-oriented departments, institutes, and laboratories provides excellent training for persons seeking professional skills for energy policy planning, research, and development.

F. Conclusion

The primary energy emphasis in Hawaii is the development of low-polluting alternative energy sources. Sources which appear to offer the greatest potential for future use include geothermal, wind, solar, ocean thermal, and solid waste/bioconversion. Because the federal and state governments regard energy research and development as a priority concern and because Hawaii contains ideal climatic and geographic conditions for conducting such activities, the opportunities for professionals in this area are showing significant development. The state government is engaged more in policy development than actual research, with research monies allocated to appropriate university and private sector personnel.

Selected Post Secondary Institutions With Formal Environmental Energy Programs

Two environmental programs are offered through the University of Hawaii, Maonoa campus: Liberal Studies, Environmental Studies Emphasis and Public Health with Environmental Health Concentration. Two career options are available in the Liberal Studies Program, a Social Ecology Option and a Natural Ecology Option. The Social Ecology Option offers the student the opportunity to study programs in Environmental Psychology, Political Design and Futuristics, Conservation and Resource Management, and Ecological Anthropology. The Natural Ecology Option emphasizes the scientific and technological aspects of the environment. Students enrolled in this option may elect courses in geology, oceanography, and specialized botany and zoology curricula.

The Public Health and Environmental Health Concentration is a master's level degree program. The program which was developed in approximately 1972 requires thirty semester hours of credit for graduation.

These two programs are examined in detail in the section immediately following this narrative. The student enrollment, faculty commitment, and program course offerings are reviewed.

Currently, there are no environmental programs offered through the community colleges. Nevertheless, individual courses are offered through the existing departmental structures. A vocational program in sewage treatment plant operation is being developed. At present, only two courses, chemistry and microbiology, are available under this program.

SENIOR INSTITUTIONS

University of Hawaii, Manoa Campus
Honolulu, Hawaii

Program: Liberal Studies - Environmental Studies Emphasis (B.A.)

Hours required for major: Semester - 30
Program Inception: 1976
Staff Size: Three half-time professionals, with support from other university departments
Enrollment: 21
Graduates (1976): 20
Placement: 2
Graduate Work: 2

Courses - Social Ecology Option

Man's Natural Environment
Technology, Ecology, and Man
American Environment: Survey
Planning Perspectives
Ecological Anthropology
Alternative Environmental Futures
Environmental Psychology
Ecology and Development
Technology and Society
Conservation and Resource Management
Perspectives on Environment and Culture
Introduction to Political Design and Futuristics
Political Philosophy and Theory
Survey of Demography and Ecology

Courses - Natural Ecology Option

Man's Natural Environment
Technology, Ecology, and Man
American Environment: Survey
Planning Perspectives
Fundamentals of Biology
Man, the Oceans and the Environmental Crisis
Fundamentals of Geology and Geophysics
Science of the Sea
Natural History of Hawaiian Islands
Technology for Non-Technologists
Plants, Man and The Ecosystem
Geology of Earth's Resources

Program: Public Health with Environmental Health Concentration
(M.P.H., M.S.P.H.)

Hours required for major: Semester - (M.P.H., M.S.P.H.) 30
Program Inception: Approximately 1972
Staff Size: Three part-time faculty members, with support from six persons in other departments
Enrollment: 25
Graduates (1976): not available
Placement: Approximately 70-80%
Graduate Work: not available

Courses

Not available at this time.

State Legislation

HAWAII GENERAL

TITLE:

Environmental Quality Control Law
Hawaii Revised Statutes 341

PURPOSE:

To stimulate, expand and coordinate efforts to determine and maintain the optimum quality of the environment, and to create the Office of Environmental Quality Control.

DEFINITIONS:

1. Director
2. Center
3. Council
4. Office
5. University

ADMINISTERING AUTHORITY:

Office of Environmental Quality Control

AUTHORIZATIONS:

To coordinate environmental activities;
To assist in public education of ecological and environmental matters;
To conduct quality monitoring;
To recommend long-range environmental goals;
To create and assign duties to the University of Hawaii Environmental Center and the Environmental Council.

HAWAII GENERAL

TITLE:

Environmental Quality Commission Law
Hawaii Statutes, Chapter 343

PURPOSE:

To provide for the creation of an Environmental Quality Commission and to establish guidelines for environmental impact statements.

DEFINITIONS:

1. Acceptance
2. Action
3. Agency
4. Applicant
5. Commission
6. Environmental impact statement
7. Person
8. Significant effect

ADMINISTERING AUTHORITY:

Environmental Quality Commission

AUTHORIZATIONS:

Environmental impact statements (EIS) required for all actions involving state or county lands or state or county funds having a significant effect on environment;
EIS for any conservation area, shoreline, historic site;
To review and accept EIS from various agencies;
To issue regulations particularly concerning EIS, formal procedures, approval criteria.

HAWAII GENERAL

TITLE:

State Environmental Policy Act
Hawaii Statutes, Chapter 344

PURPOSE:

To establish a state policy which will encourage productive and enjoyable harmony between man and his environment, and prevent or eliminate damage to the environment.

DEFINITIONS:

1. Agency
2. Environment

ADMINISTERING AUTHORITY:

All State Departments, Boards, Commissions

AUTHORIZATIONS:

To pursue, through actions, a state policy of conservation, pollution abatement, population limits, and community enhancement;
To consider, in all policies, the following guidelines: population, natural resources, flora and fauna, parks, recreation, economic development, transportation, energy, community life, education, and citizen participation.

HAWAII GENERAL

TITLE:

Hawaii Statute on Environmental Quality
Hawaii Revised Statues 342

PURPOSE:

To provide for improved environmental quality of Hawaii by controlling air pollution, water pollution, noise pollution, solid waste pollution and other forms of pollution as are found in the state.

DEFINITIONS:

1. Air pollution
2. Approved solid waste disposal system
3. Coastal waters
4. Complaint
5. Department
6. Director
7. Drainage ditch
8. Effluent
9. Effluent sources
10. Excessive noise
11. Hazardous waste
12. Incineration
13. New source
14. Open dump
15. Party
16. Permit
17. Person
18. Pollution
19. Sanitary landfill
20. Sewerage System
21. Solid waste
22. Standard of performance
23. State waters
24. Treatment works
25. Variance
26. Waste
27. Water pollution

ADMINISTRATIVE AUTHORITY:

Department of Health

AUTHORIZATIONS:

To issue regulations pursuant to the act for the control of air, water, noise, and solid waste pollution;
To issue permits and variances for purposes set forth in the act;
To issue cease and desist orders;

To enter and inspect to determine compliance with the act;
To conduct research related to air, water, noise and solid waste pollution;
To carry out permit programs related to air and water contaminants;
To make grants for water treatment works construction;
To cooperate with, and receive funds from the federal government for pollution abatement programs.

CERTIFICATION OR LICENSING:

Installation and operation permits are required for sources of air pollution which may affect ambient air quality;
General effluent discharge permit requirements are established.

PROHIBITED ACTS:

To engage in activity which causes noise, air, or water pollution;
To violate the conditions of any permit;
To operate open dump or unapproved solid waste disposal system.

PENALTIES:

Vehicular noise or smoke violations--$25 to $2500;
Open burning violations--up to $10,000;
Other violations--up to $10,000;
Criminal penalties for willful or negligent violations--$2500 to $25,000 or one year imprisonment.

HAWAII PESTICIDES

TITLE:

Hawaii Pesticides Law
Hawaii Revised Statutes 149A

PURPOSE:

To provide for the control of pesticides sales and uses, to require that applicators be properly qualified, and to ensure the proper labeling, registration and classification of pesticides.

DEFINITIONS:

1. Active ingredient
2. Adulterated
3. Animal
4. Board
5. Certified pesticide applicator
6. Chairman
7. Commercial pesticide applicator
9. Defoliant
10. Desiccant
11. Device
12. Environment
13. Fungi
14. General use pesticide
15. Imminent hazard
16. Inert ingredient
17. Ingredient statement
18. Insect
19. Label
20. Labeling
21. License
22. Licensee
23. Misbranded
24. Nematode
25. Person
26. Pest
27. Pesticide
28. Plant regulator
29. Private pesticide applicator
30. Producer
31. Protect health and environment
32. Restricted pesticide
33. Registrant
34. Sell or distribute
35. Under the direct supervision of
36. Unreasonable adverse effect on environment
37. Weed

ADMINISTERING AUTHORITY:

Department of Agriculture
Board of Agriculture

AUTHORIZATIONS:

To license all pesticides;
To require proper labeling of pesticides;
To issue regulations pursuant to the act declaring pests and controlling use;
To issue stop sale and removal orders;
To establish applicator certification standards.

CERTIFICATION OR LICENSING:

The Department shall carry out certification procedures to certify commercial and private applicators in various categories upon examination and demonstration.

PROHIBITED ACTS:

To apply pesticides contrary to label;
To use, store or discard pesticides and containers in manner to harm environment;
To apply restricted pesticides without proper certification;
To sell, transport or use nonlicensed, misbranded, adulterated or illegal pesticides;
To alter or deface pesticide labels.

EXEMPTIONS:

Public officials and research activities.

PENALTIES:

Fines of up to $1,000.

HAWAII PESTICIDES

TITLE:

Pest Control Operators
Hawaii Revised Statutes 460J

PURPOSE:

To provide a means of licensing and regulating persons in the business of pest control, fumigation, or other structural pest operations.

DEFINITIONS:

1. Board
2. Director
3. Fumigation
4. Fumigator
5. Household pests
6. Pest control
7. Pest control operator

ADMINISTERING AUTHORITY:

Pest Control Board

AUTHORIZATIONS:

To issue regulations pursuant to the act;
To control storage, transportation, or disposal of pesticides;
To categorize and certify commercial applicators;
To investigate pesticide damages and violations.

CERTIFICATION OR LICENSING:

Commercial applicators must be certified by examination and other qualifications in one of following categories: fumigation, termite, general pest.

PROHIBITED ACTS:

To engage in pest control or fumigation business without proper license.

EXEMPTIONS:

Certain public personnel, military personnel, and persons engaged in agricultural pest control.

PENALTIES:

Criminal fine of up to $500 or up to 6 months in prison.